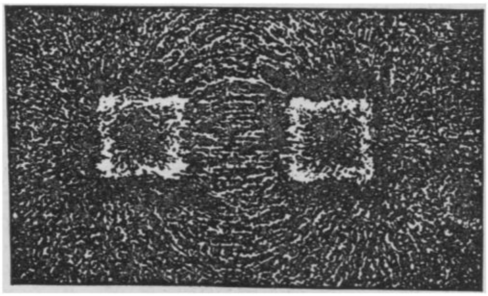
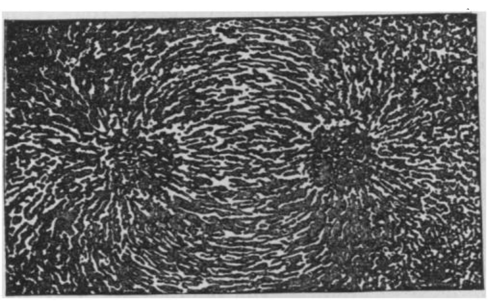
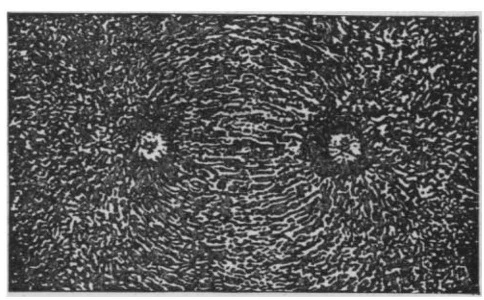
inch holes concentric with the disk, the number of holes in the two circles being thirty-two and sixty-four respectively. On one side of the disk was placed a horse-shoe magnet with its poles very near the rows of holes; on the other side were arranged two corresponding induction bobbins. The circuit was completed through a telephone and either bobbin at pleasure. Upon rotating the disk rapidly, a clear musical sound was produced in the telephone, the pitch rising with the rapidity of rotation. Moreover the bobbin opposite the circle of sixty-four holes gave the octave above the other, and each gave a note of the same pitch as was produced by blowing a stream of air through the corresponding holes. Hence, as a beam of light, focused upon a circle of equi-distant holes in an opaque disk, is rendered periodically intermittent by the rotation of the disk, and produces a musical tone when falling upon the proper receiving-apparatus; so the lines of force proceeding from a magnet may be rendered periodically intermittent in their action on an induction bobbin by a similar metallic disk, set in rapid rotation; and the induced currents, arising from the periodic change of magnetism in the core of the bobbin, produce a musical tone in a telephone, the pitch depending in both cases only upon the number of holes passing in unit time.



MAGNETIC CURVES OVER HORSE-SHOE MAGNET.



EFFECT OF SCREEN OF SHEET IRON.



EFFECT OF HOLES THROUGH THE IRON SCREEN.

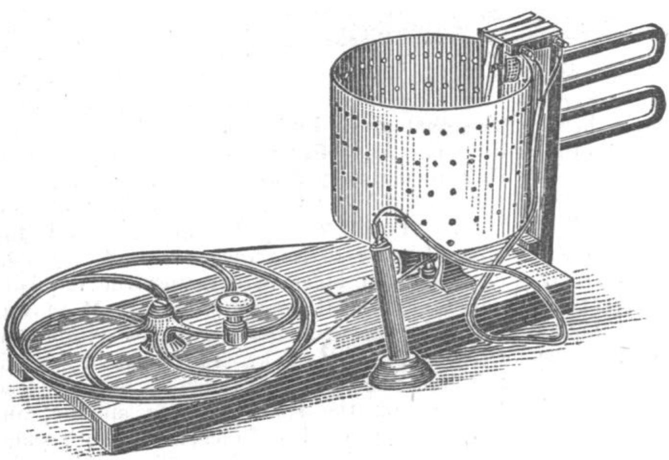
The experiment was modified by so placing the poles of the magnet that the same circle of holes passed them in succession. By the proper connections, the currents from the two bobbins were made to pass either in the same or in opposite directions through the telephone. In the latter case, an almost perfect neutralization of currents took place, so that the sound was scarcely audible.

Non-magnetic metallic disks produce similar musical notes by the periodic modification of the magnetic field by means of the distortion or bending of the lines of force. The solid parts of the conducting disk deflect the lines of force in the direction of the rotation; but upon the passage of a hole, they fall back toward their normal position. A periodic movement of the lines of force will, therefore, take place when the disk rotates. Disks of zinc and copper produce a clear musical sound, somewhat less intense than that given by iron under the same conditions. Any discontinuity in the rotating disk recurring periodically will produce corresponding induction currents in the bobbins. Thus, V-shaped notches round the circumference of the disk are quite as efficient as the holes in effecting the requisite modification of the magnetic field. Moreover, it is not necessary that the holes extend entirely through the disk. Two disks of zinc, of the same diameter and thickness, were placed together on the same rotating spindle, one pierced with a circle of holes, and the other not. The combination proved as efficient in producing the sound as the single perforated disk. A sheet of tinfoil, with a circle of small holes, was pasted on the continuous zinc disk. The perforations, extending only the thickness of the tinfoil into the compound disk, constituted a sufficient discontinuity to produce a clear,

though somewhat faint, musical sound. About the same result was given by a disk consisting of the same sheet of tinfoil pasted on cardboard.

Any periodic variation from uniformity in the disk appears to produce corresponding variations in the magnetic field when the disk is rotated. Depressions made with a punch, at regular intervals, in a zinc disk, rendered it a sound-generator when rotated in this apparatus.

Since the pitch of the note obtained depends only on the number of holes passing the pole of the magnet in a second, it is easy to construct a piece of apparatus to illustrate musical intervals. A cylinder of galvanized iron, with four rows of holes in the ratio of 4 : 5 : 6 : 8, was



mounted on a whirling table, and provided with two U-magnets and two electro-magnets for induction. The latter were placed inside the cylinder, and the former outside. By means of four keys, any one of the bobbins, or all of them, can be put in circuit with the telephone. By depressing the keys, the four notes of the common. or major, chord are brought out with great distinctness and clearness. In fact, the intensity of the sounds obtained by the magnetophone is sometimes so great as to be painful to the ear when the telephone is held closely against it.

The above experiment was simplified by employing a disk perforated in four concentric circles with 24, 30, 36, and 48 holes respectively. A telephone with the mouthpiece and diaphragm removed, was presented to the four rows of holes in succession, with the production of the four notes of the major chord as before, clearly defined, but not so loud as with the other apparatus. Further experiments are in progress. H. S. CARHART.

Evanston, Ill.

THE WEATHER IN JULY, 1883.

THE monthly weather review of the U.S. signal service shows that the most noteworthy characteristics of July were the large deficiencies in rainfall in the southern states and in the north-west, the low mean temperature in nearly the whole country, and the severe local storms, which were frequently accompanied by lightning and hail.

The pressure was nearly normal, the departures in few instances exceeding .05 inch. The progress of eight depressions has been charted. Only one of these passed south of New England, and none visited the southern states. None were traced from the Pacific coast, and four apparently developed in the Rocky-mountain region. One only of these depressions is deserving of the name of a severe storm. This developed in Colorado on the 4th, and reached Nova Scotia on the 7th, accompanied by heavy rains in the lake region, and violent local winds at Hatteras and Sandy Hook. The storm proceeded across the Atlantic, and on the 11th was central off the north-western coast of Ireland, causing heavy squalls and high seas during its passage.

The chart of ocean-ice shows, that, since the preceding month, the eastern limit has moved about 2° westward, and the southern limit about 2° northward. There is a marked diminution in the number of icebergs observed, compared with July, 1882.

The temperature has been below the average, except in the Pacific districts, the northern plateau region, the south Atlantic and east gulf states; but the departures have been small. In New England, the middle Atlantic and west gulf states, the temperature was less than 1° below the normal, while the greatest difference was 3° below in the extreme north-west. A maximum of 112° was recorded at Phœnix, Arizona; and frosts occurred in northern New York, Michigan, Wisconsin, Iowa, New Hampshire, and Pennsylvania.

The special feature in the precipitation record